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(54) Process for the Production of Fermented Beverages

(57) A process for producing a fermented beverage including forming two worts of differing original gravity and/or fermentable carbohydrate content. One wort is fermented to give a first liquor and a volatile product stream. The other wort is fermented to give a second liquor. Both liquors may be further fermented before or after mixing them together. The volatile products are incorporated into the other wort prior to fermentation, into the resulting fermented liquor or into the mixed first and second liquors. The Examples are directed to the production of low alcohol lager and stout, respectively.

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SPECIFICATION

Process for the Production of Fermented Beverages

Background of the Invention

This invention relates to the production of beers and like fermented beverages having low alcohol contents.

Many processes have been proposed for the production of beers with low alcohol contents. The demands for such beers have been influenced by consideration of health requirements, for the benefit of persons whose alcohol intake should be restricted, and by consideration of social responsibilities, in order to ensure that persons, such as motorists and others, do not inbibe excessive amounts of alcohol.

However, various processes which have been proposed for the production of such beers with low alcohol contents have defects, some of which are now indicated.

Evaporation methods have been employed to reduce the alcohol content of beers and, although such processes are effective in this respect, special expensive equipment is required to achieve the elimination of alcohol. Further, during such distillations chemical changes occur and important flavour components are removed with the distillate, resulting in losses of character and quality characteristics, particularly with respect to flavour, taste and aroma, so that the resultant low alcohol beers are markedly different from conventional beers.

Some other processes achieve low alcohol contents in beers by terminating the fermentation stages permaturely, procedures for which include separation of yeast followed by pasteurization and sterilization of the young beer. Such processes prevent maturation of these beers and again result in loss of character or quality characteristics. In addition, the worts employed for the production of such beers are frequently of low original gravities, as a result of which the composition of the low alcohol beers will differ markedly from conventional beers.

Another process now used for the production of beer with a reduced, low or no alcohol content involves dilution of normally fermented beer by addition of water then extracting therefrom by reverse osmosis a mixture of alcohol and water. Although the reverse osmosis operation is not completely selective for water and alcohol alone, it has been claimed that this process effectively produces the desired beer with acceptable taste and aroma qualities. But again, special equipment is required and a process, separate from that employed in conventional brewing, must be applied to achieve the low alcohol beer.

It is an object of the present invention to provide an improved process for the production of beverages manufactured by fermentation processes, such as beers, lagers, ales, stouts, porters and the like, with alcoholic contents lower than those normally encountered in such beverages, without compromising the character or quality characteristics of the resultant beers, lagers, ales, stouts, porters and the like, or low alcohol content.

For the sake of convenience in the following discussion, the term 'beer' will be taken to refer to such fermented beverages as are described as beers, lagers, ales, stouts, porters and the like, whether such products are manufactured by bottom fermentation processes, top fermentation processes, continuous fermentation processes, stirred fermentation processes or other fermentation processes.

Summary of the Invention

According to the present invention there is provided a process for producing a fermented beverage including:

a) forming two worts, said worts differing in original gravity and/or fermentable carbohydrate content,

b) subjecting one of said worts to primary fermentation to obtain a first liquor and a stream containing volatile products,

c) subjecting the other of said worts to primary fermentation to obtain a second liquor,

d) mixing said first and second liquor, and if desired,

e) subjecting said first and said second liquor to secondary fermentation,

at least some of said volatile products being (i) added to said other wort between steps (b) and (c) above; (ii) added to said second liquor between steps (c) and (d) above; or (iii) added to said first and said second liquor after mixing said liquors.

Description of the Preferred Embodiments

The invention preferably utilizes conventional brewing processes which include the production of wort for fermentation by conventional means from a grist comprising one or more of the following malted or unmalted cereal grains, barley, wheat, maize, corn, rye, sorghum, rice, oats or other cereal grains, with or without the addition of processed or unprocessed cereal adjuncts from these or other cereal grains, with or without the addition of exogenous commercial enzymes, with or without the addition of sugars, brewing syrups or caramels, with or without the addition of special malts such as acid, diastatic, amber, crystal, chocolate, black or others, with or without the addition of hops or hop products, such wort having the character or quality characteristics of worts for fermentation to produce

conventional beers. Dependent upon the nature of the beer to be produced, the original gravity (sometimes called "original extract") of such wort might lie in the range from less than 8° Plato to more than 18° Plato. For illustrative purposes in this description, this wort after boiling will be considered to have an original gravity of 10° Plato and will be referred to as Wort A, the wort of normal, high gravity.

A part of the invention requires the production of a similar wort prepared in a similar manner to that referred to in the preceding paragraph, but differing from that wort ("Wort A") by reducing in a proportionate manner, the amounts of carbohydrate sources in the grist, primarily malted or unmalted cereal grains, and adjusting those components which will produce an identical colour to that of the conventional wort after boiling. The resultant wort, subsequently referred to in this description as Wort B, will, in this embodiment of the invention, have a lower original gravity than Wort A.

The magnitude of the original gravity of Wort B should correspond preferably with the real gravity (or "real extract") of the beer which would be produced by the fermentation of Wort A.

Whilst the values for real gravity of beers range from approximately 0° Plato to more than 5° Plato, for illustrative purposes in this description, the fermented beer produced by the fermentation of Wort A, of the original gravity 10° Plato, will be considered to have a real gravity of 2° Plato. Thus, in this example, Wort B will differ from Wort A in that Wort B will have an original gravity of the order of 2° Plato. Primarily, Wort B will contain substantially lesser amounts of fermentable carbohydrates that Wort A. Dependent upon mashing conditions, Wort B may contain similar or lesser amounts of nitrogenous compounds, non-fermentable carbohydrates and other substances, as compared with Wort A. However, Wort B will be similar to Wort A with respect to colour, bitterness, substances derived from hops, pH and other character and quality characteristics.

Primary fermentation of Wort A may be conducted in fermentation vessels in identical manner with respect to aeration, yeast addition, time and temperature of fermentation, as well as other factors, to the fermentation processes employed for the manufacture of conventional beers but a preferred feature of this invention is that the volatile products of fermentation of Wort A are trasferred into the fermentation vessels containing Wort B.

Dependent upon the real gravity and alcohol requirements of the low alcohol beer to be produced, a further feature of this invention is that Wort B can be fermented simultaneously with the fermentation of Wort A and at the same time receive the volatile products from the fermentation of Wort A.

This feature of the invention involving transference of the products which are volatilized during primary fermentation of the normal, higher gravity worts into the lower gravity worts is to improve the character and quality characteristics of the final, low alcohol beers by retaining the volatile flavour, aroma and taste components in order to attain chemical composition comparable to that of conventional beers. Such volatile products arising from fermentation of the normal gravity worts may be conveyed directly into the low gravity worts through distributors located in the bases of the fermentation vessels containing the low gravity worts.

Another aspect of the invention is that a cooled condensation trap may be interposed in the ductwork used for the transfer of the volatile products of fermentation between the fermentation vessels containing the worts of higher and lower gravity to effect the condensation of readily condensible products of fermentation.

Alternatively, a water scrubber and/or absorbent such as activated carbon can be used to separate the volatile products and provide a condensate or concentrate of such products. The water scrubber is preferably a system of water sprays or a packed tower through which water flows countercurrently to the stream containing the volatile products which enters the scrubber to provide intimate contact between the stream and water so as to effect dissolution of water soluble components of the stream. The effluent gas from the water scrubber may be passed through an adsorbent, such as an activated carbon purifier, to effect adsorption of organic compounds of low water solubility which have not been dissolved in water during passage through the water scrubber. These adsorbed compounds may be recovered from the adsorbent by passing heated air (at approx. 200°C.) or, to avoid possible oxidation of such adsorbed compounds, heated carbon dioxide or heated nitrogen (at approx. 200°C.) through the adsorbent, followed by cooling the gaseous mixture to effect condensation of the preciously adsorbed organic compounds. According to the chemical composition, such condensates may be blended, wholly or partially, with the low alcohol beer as this is received in the storage or secondary fermentation cellars.

Regardless of the means by which the volatiles released with carbon dioxide during fermentation are recovered, the resultant concentrate of taste, flavour, aroma, odoriferous components may be utilized as described in this patent application for the production of beers of the desired taste, flavour, aroma, odoriferous composition. In addition, or alternatively, such concentrates may be employed for addition to other beverages, foods, etc., to provide taste, flavour, aroma, odoriferous sensations comparable to those encountered in conventional beers.

A preferred feature of the invention is that when primary fermentation of the normal gravity wort, Wort A, is completed, the green beer from Wort A is transferred to storage or secondary fermentation cellars, using the same procedures as those employed in the production of conventional beers, but at the time of transfer it is blended with the lower gravity wort, Wort B, which has absorbed the volatile

products from the fermentation of Wort A or with the green beer resulting from the fermentation of Wort B which has absorbed the volatile products from the fermentation of Wort A, in such proportions as are required to attain the desired lower alcohol content of the final low alcohol beer.

On completion of the period allowed in the storage or secondary fermentation cellars for the production of conventional beers, the blended low alcohol beer is processed for final packaging following the procedures employed in the production of conventional beers. During carbonation of the blended low alcohol beer, purging with carbon dioxide can be continued, if required, to reduce the concentration of readily volatile flavour components to levels encountered in conventional beers. The processes and operations for finishing beers, including filtration, stabilization, post-fermentation bittering and pasteurization, are identical with those used for conventional beers.

A desirable feature of the invention is that the transfer of the volatile products of fermentation from the normal, higher gravity worts into the lower gravity worts or green beers resulting in the dissolution of such volatiles in the low gravity worts or green beers, may be used to ensure uniformity of concentration of these flavour components is achieved in both products before blending.

Another feature of the invention is that the concentrations of the flavour, aroma and taste components of the volatile products of fermentation in the final blended low alcohol beers may be adjusted to levels corresponding to those encountered in conventional beers. During the carbonation phase of the low alcohol beer, significant aroma contributors, including vicinal diketones, dimethyl sulphide, acetaldehyde and others, can be purged out to a desired extent with excess carbon dioxide, in an equivalent manner to that occurring during conventional fermentation operations.

Another feature of the invention is that as identical brewing liquor or brewing water can be used for mashing to produce both normal gravity and lower gravity worts, the effects of dissolved salts and pH will be to yield worts which are similar with respect to those components which ultimately contribute to flavour, aroma, taste head formation and head retention in the final low alcohol beer. Also, as boiling conditions for both worts can be made identical, chemical reactions and precipitations will be similar for both worts. Thus, on blending to produce the low alcohol, young, green beer, such flavour components will not be diluted and can be maintained at levels correponsing to those encountered in conventional beers. The significant flavour and other components referred to in this sense include proteins, peptides, amino acids, alpha glucans and dextrins, beta glucans and hemi-cellulosic gums, lipids, polyphenols, mucleic acid derivatives, vitamins, inorganic constituents and other minor constituents.

A related feature of the invention is that when hopping is effected during wort boiling in the kettle, both normal gravity and lower gravity worts can attain the desired levels of bitterness and of hop aroma compounds and that the changes in concentrations of such substances undergone during subsequent brewing operations will be similar for both worts and both green beers. Again, dilution steps, with corresponding variations in brewing conditions, are avoided.

In another embodiment of the invention, mashing conditions for the production of the worts can be varied to produce worts of normal gravity but of low fermentability leading to beers of low alcohol content but of relatively high gravity. Such conditions could involve mashing cereal grists at such temperatures as to restrict conversion of starch to fermentable sugars but to allow dissolution of high molecular weight, non-fermentable carbohydrates, together with an increased proportion of nitrogenous compounds.

A further aspect of the invention is that it can be applied to the production of so-called diet beers or low calorie beers, but with low alcohol contents. In such cases, both the normal gravity and lower gravity worts are treated with exogenous commercial enzymes, as in the production of conventional diet or low calorie beers, in order to degrade soluble carbohydrates into sugars and subsequent operations follow the procedures previously described.

In the application of the invention to continuous fermentation processes, it is necessary to pass the lower gravity wort through the fermentation unit before the normal gravity wort in order that the volatile products from the fermentation of the latter wort can be transferred into the lower gravity batch held in its collecting vessel. Again, subsequent operations follow the procedures previously described.

It should be noted that it is the perogative of the brewer to choose cereal grists, hops and yeasts and to decide upon gravities of worts, hopping rates, temperatures and durations of fermentations and other brewing processes as employed in the production of conventional beers.

Applications of the invention will be indicated by reference to the following examples.

Example 1

Low Alcohol Lagers produced by Bottom Fermentation.

A cereal grist was prepared from lager and crystal malts and mashed to yield a wort which, after boiling with hops, had a gravity of 10.0° Plato, a bitterness value of 30 I.B.U. and a colour of 10° E.B.C. (Wort A).

Similarly, a cereal grist was prepared from lager and crystal malts and mashed to yield a wort which, after boiling with hops, had a gravity of 3.0° Plato, a bitterness value of 26 I.B.U. and a colour of 8° E.B.C. (Wort B).

These worts were transferred, separately, into fermentation vessels arranged in series so that the volatile products evolved during fermentation of Wort A entered the base of the fermentation vessel containing Wort B by means of sintered glass distributors.

After aeration of the worts in the fermentation vessels, each wort was pitched with yeast (Saccharomyces Carlsbergensis) at the rate of 3 grams of pressed yeast per litre of wort and fermentation was allowed to proceed for 7 days at 12°C. The resultant young lagers from Worts A and B were decanted from flocculated yeast and, after analysis, were transferred to secondary fermentation vessels, blending the young lagers in various proportions as shown below.

Analytical Results for Young Lagers

	Young Lager from Wort A	*Young Lager from Wort B*
Extract, ° Plato	2.9	2.8
Colour, ° E.B.C.	8.0	7.5
Bitterness, I.B.U.	25	24
Alcohol, grams per 100 ml	3.4	0.3

Alcohol Contents of Low Alcohol Lagers

Ratio, by volume for blending young lager from Wort A with young lager from Wort B	*Alcohol content of blended lager grams per 100 ml*
2 : 1	2.4
1 : 1	1.8
1 : 2	1.3
1 : 3	1.1
1 : 4	0.9

Example 2

Low Alcohol Stouts produced by Bottom Fermentation

A cereal grist was prepared from lager and black malts and mashed to yield a wort which, after boiling with hops and addition of caramel, had a gravity of 16.0° Plato, a bitterness value of 46 I.B.U. and a colour of 190° E.B.C. (Wort A).

Similarly, a cereal grist was prepared from lager and black malts and mashed to yield a wort which, after boiling with hops and addition of caramel, had a gravity of 4.0° Plato, a bitterness value of 41 I.B.U. and a colour of 180° E.B.C. (Wort B).

The procedures described in Example I were then followed.

Analytical Results for Young Stouts

	Young Stout from Wort A	*Young Stout from Wort B*
Extract, ° Plato	4.1	3.7
Colour, ° E.B.C.	180	175
Bitterness, I.B.U.	41	39
Alcohol, grams per 100 ml	6.2	0.5

Alcohol Contents of Low Alcohol Stouts

Ratio, by volume, for blending young stout from Wort A with young stout from Wort B	*Alcohol content of blended stout grams per 100 ml*
2 : 1	4.3
1 : 1	3.4
1 : 2	2.4
1 : 4	1.7

In each of the cases reported under Examples 1 and 2, the characteristic flavour components, e.g. bitterness, alcohols (excluding ethanol), esters, carbonyl compounds, sulphur compounds, hop volatiles, and so on, appeared to give similar flavour responses in the lower alcohol products as compared with the normal products. Also, appearances of the lower alcohol products, as indicated by colour, head formation and head retention, were similar to those of the normal products.

It will be seen then that according to the present invention, beers with low alcohol contents of pre-determined values and with the character and quality characteristics of conventional beers can be produced with conventional brewing plant, without the need for specialized expensive equipment and without the introduction of special processes.

Using the principles of the invention one is able to produce

(a) low alcohol beers which retain the distinctive character or quality characteristics of individual conventional beers manufactured by individual brewers by their distinctive methods with their particular raw materials.

(b) low alcohol beers which can be described as non-intoxicating whereby the ethanol content of the resultant beers can be controlled to less than 1% by weight of ethanol per 100 ml of beer whilst retaining the character and quality characteristics of conventional beers as desired.

(c) low alcohol beers containing from less than 1% by weight of alcohol per 100 ml of beer to more than 4% by weight of alcohol per 100 ml of beer, as desired, whilst retaining the character and quality characteristics of the corresponding conventional beers.

(d) low alcohol beers which retain the flavour, aroma, taste, bitterness, colour, head formation, head retention, appearance and other character and quality characteristics of the corresponding conventional beers.

(e) low alcohol beers without the need to install special items of equipment for removal of alcohol nor to deviate from conventional methods of wort production and of fermentation equipment.

(f) low alcohol beers the chemical composition of which, with the exception of alcohol content, approximates to that of the corresponding conventional beers.

In taste testing evaluations, the beers produced by my processes showed flavour/aroma characteristics comparable with conventional beers and that the "beeriness" of the low alcohol beers was quite definite.

It will be appreciated of course that many variations, modification and additions may be made to the above described process without departing from the ambit of the present invention. It will also be appreciated that the word "liquor" is used in relation to the wort fermentation products in its generic sense. Thus, "liquor" in this context is to be understood as referring to the predominantly liquid phase produced and not to be construed in any limiting sense as may apply to this word in the brewing art.

Claims

1. A process for producing a fermented beverage including

a) forming two worts, said worts differing in original gravity and/or fermentable carbohydrate content,

b) subjecting one of said worts to primary fermentation to obtain a first liquor and a stream containing volatile products,

c) subjecting the other of said worts to primary fermentation to obtain a second liquor,

d) mixing said first and second liquor, and, if desired,

e) subjecting said first and said second liquor to secondary fermentation,

at least some of said volatile products being (i) added to said other wort between steps (b) and (c) above; (ii) added to said second liquor between steps (c) and (d) above; or (iii) added to said first and said second liquor after mixing said liquors.

2. A process according to claim 1 wherein said volatile products are added to said other wort before said other wort is subjected to primary fermentation to obtain a second liquor and said first and second liquor are subjected to secondary fermentation.

3. A process according to any preceding claim wherein said other wort is passed through a fermentation vessel and placed in a separate vessel prior to subjecting said one wort to primary fermentation in said fermentation vessel.

4. A process according to any preceding claim wherein the primary fermentation of said worts is carried out simultaneously with said volatile products from said one wort being conveyed into a fermentation vessel containing said other wort.

5. A process according to claim 4, wherein said volatile products are conveyed through a distributor positioned in the vessel's base.

6. A process according to any preceding claim wherein said volatile products are separated from said stream by means selected from a condensation trap, a water scrubber and an absorbent before addition of said volatile products to said other wort of fermented liquor.

7. A process according to any preceding claim wherein the original gravity of the other wort is substantially the same as that of the real gravity of the fermented beverage which would be produced by the fermentation of the said one wort.

8. A process according to claim 1, substantially as herein described with reference to either of the Examples.

9. A fermented beverage whenever produced by a process according to any preceding claim.

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